



**UNITED STATES DISTRICT COURT  
SOUTHERN DISTRICT OF NEW YORK**

JOANNE HART and SANDRA BUENO, on  
behalf of themselves and all others similarly  
situated,

Plaintiffs,

v.

BHH, LLC d/b/a Bell + Howell and VAN  
HAUSER LLC

Defendants.

Civil Action No. 1:15-CV-04804-WHP

**EXPERT REPORT OF DR. MICHAEL F. POTTER**

Dated: October 31, 2017

## TABLE OF CONTENTS

	<b>Page(s)</b>
I. INTRODUCTION .....	1
II. EDUCATION, WORK EXPERIENCE, PUBLICATIONS, RECOGNITION .....	1
III. DATA AND OTHER INFORMATION CONSIDERED .....	3
IV. COMPENSATION .....	3
V. OTHER TESTIMONY .....	3
VI. OVERVIEW OF ULTRASONIC AND ELECTROMAGNETIC TECHNOLOGY .....	3
VII. TESTING AND ANALYSIS OF THE ELECTRONIC OUTPUT FOR BELL + HOWELL ULTRASONIC PEST REPELLERS.....	6
VIII. TESTING OF BELL + HOWELL ULTRASONIC PEST REPELLERS SHOWS THE DEVICES TO BE INEFFECTIVE .....	8
A. Insect and Spider Tests (Methods).....	9
B. Insect and Spider Tests (Results).....	11
C. Rodent Tests (Methods).....	12
D. Rodent Tests (Results) .....	15
IX. TESTING OF COMPARABLE DEVICES SHOWS THAT THE ULTRASONIC AND ELECTROMAGNETIC TECHNOLOGY USED IN THE BELL + HOWELL DEVICES IS INEFFECTIVE.....	18
A. Cockroaches .....	19
B. Ants .....	22
C. Spiders.....	23
D. Rodents .....	23
E. Summary of Studies .....	28
X. DEFENDANTS' FLAWED EXPERIMENTS YIELD FALSE CONCLUSIONS.....	29

## **I. INTRODUCTION**

1. I have been asked to provide expert testimony on behalf of Plaintiffs in the certified class action *Hart, et al. v. BHH, LLC d/b/a Bell + Howell, et al.*

2. At trial, I intend to testify as to the ineffectiveness of products manufactured and sold by Defendants, Bell + Howell for repelling and driving ants, cockroaches, spiders, mice, and rats out of dwellings. For the reasons stated herein, I conclude that the devices are ineffective for their stated purposes and can neither repel nor drive out any of these critters.

3. I reserve the right to supplement, change, clarify, or modify my opinions should additional information and/or documentation become available to me. I also reserve the right to submit a rebuttal report in response to any expert reports(s) submitted by Defendants.

## **II. EDUCATION, WORK EXPERIENCE, PUBLICATIONS, RECOGNITION**

4. A copy of my curriculum vitae including a list of my publications is attached hereto as Appendix 1.

5. My educational training includes a B.S. degree from Cornell University (1977), and M.S. (1979) and Ph.D. (1982) degrees from the University of Arizona. All three degrees were in entomology with an emphasis on pest management. Upon graduation, I worked as a research entomologist and program manager for Union Carbide Agricultural Products Company (1982-85) and Rhone-Poulenc (1985-88). While at Union Carbide and Rhone Poulenc, my responsibilities included domestic and international development of insecticides, including for control of household pests. My job functions included design and management of research testing programs, submission of product registrations, and technical support on regulatory issues.

6. In 1988, I left the agrichemical industry to become National Technical Director for Orkin, the world's largest pest control company. My responsibilities for Orkin included all technical aspects of company operations, including testing, evaluation, and selection of

pesticides, equipment, traps and devices for controlling insects and rodents, and procedures for managing insects and rodents in both residential and commercial settings (homes, apartments, hotels, hospitals, schools, restaurants, office buildings, etc.). Further, I provided technical training and on-site support for the company's 6000-plus employees, offices and customers. Cockroaches, ants, spiders, and rodents (rats and mice) were some of the most common pests we managed.

7. Following my three and a half years at Orkin, I joined the University of Kentucky in 1991 as an Extension Professor of Urban Entomology. Much of my time during the past 26 years has been spent solving insect and rodent problems, especially for property owners and the professional pest control industry. I have authored publications on cockroaches, ants, spiders, rodents, and other household pests, and have been an invited lecturer on pest control throughout the world. I have also served as a technical advisor to the National Pest Management Association, state regulatory agencies, the Federal Trade Commission, and most of the major suppliers of pest control products and services including Orkin, Terminix, Bayer, BASF, Dow, Syngenta, Scotts/Ortho, and S.C. Johnson. Throughout my career as a practicing urban entomologist and pest management expert, I have evaluated numerous devices, including electronic pest repellers for their effectiveness against insects and rodents. I am familiar with the operation, performance, and limitations of such devices, and have informed and counseled the professional pest management industry and the public about them.

8. I am the only contemporary academician to be honored with the National Pest Management Association Pinnacle Award (2011) and Pest Control Hall of Fame Award (2012), the two highest lifetime achievement awards presented by the professional pest control industry. In 2013, the University of Kentucky honored me with the title of "Provost's Distinguished

Service Professor.” I was also the 2016 recipient of the Entomological Society of America’s Distinguished Achievement Award in Urban Entomology, and the 2017 Kentucky Pest Management Association Lifetime Achievement Award.

### **III. DATA AND OTHER INFORMATION CONSIDERED**

9. A list of documents that I have considered in preparing my report is attached hereto as Appendix 6.

10. I am also relying on my experience and knowledge accumulated in my years of work as a practicing urban entomologist and entomological educator and researcher.

### **IV. COMPENSATION**

11. I am being compensated for my work as an expert in this case at a rate of \$375 per hour. My compensation is in no way dependent on the outcome of this case.

### **V. OTHER TESTIMONY**

12. During the previous four years, I have testified as an expert at trial or deposition in the following case:

- 2015 – ThermaPure Inc. v. RxHeat, LLC and Cambridge Engineering, Inc.  
(heat treatment patent infringement case; deposition testimony)

### **VI. OVERVIEW OF ULTRASONIC AND ELECTROMAGNETIC TECHNOLOGY**

13. Ultrasonic pest repellers operate by producing high-frequency sound waves (>20 kHz) that are inaudible to humans but detectable by some animals including rodents. Most devices generate amplitude/intensity/sound pressure levels in the 70-140 dB range as measured 12 inches from the transducer (Shumake 1995). Rats and mice are able to hear and emit ultrasonic sounds and use them to maneuver and communicate. (Meehan, 1984; Corrigan 2001). In arthropods, the ability to detect ultrasound has evolved primarily in species preyed upon by

bats— notably night-flying moths, locusts, mantids, crickets, and some beetles. Ants, cockroaches and spiders are seldom consumed by bats and therefore do not depend on ultrasound (Grimaldi and Engel 2004; Mankin 2012).

14. Electromagnetic devices were widely sold as pest repellers during the 1970s, but enforcement actions by regulatory agencies resulted in most being taken off the market (U.S. EPA 1980). Such devices supposedly work by producing a magnetic field using the electrical wiring within homes to stun, disorient and repel pests. Many household appliances also produce electromagnetic fields, including television and computer screens, cordless phones, hairdryers, blenders, toasters, ovens, and vacuum cleaners. Some of these appliances produce emissions of similar magnitude as those generated by pest repellers. In the late-1970s, the U.S. Environmental Protection Agency initiated an extensive collaborative investigation to determine if electromagnetic pest repellers were effective in controlling pests. The National Bureau of Standards performed electronic analyses of 15 different devices, concluding that the electromagnetic fields were either undetectable, or of such little strength to be less than the earth's magnetic field at three meters away from the repeller. Efficacy studies on several of the repellers were then conducted by scientists at the University of California, Davis, UC Riverside, U.S. Forest Service, U.S. EPA Animal Biology Laboratory, and Nevada State Department of Agriculture. "In more than 20 tests against 10 species of pest rodents and insects, there was no demonstrated efficacy either in field, laboratory, or simulated field tests" (U.S. EPA 1980).

15. Ultrasonic and electromagnetic pest repellers produce waves and emissions that are measurable with standard analytic equipment. The fundamental parameters that researchers use to characterize ultrasonic output are frequency and amplitude (Shumake 1995). Similar to sound audible to humans, ultrasonic sound consists of waves of a certain 'frequency' (the

number of oscillating waves produced per second) and ‘amplitude’ (wave strength or intensity). Knowing the frequency (measured in kilohertz) and amplitude (measured in decibels) of a device allows inferences to be made from studies with other devices having similar sound characteristics. If the acoustical properties of the devices are substantively the same, it matters little whether they are sold by different companies, or have different packaging, peripherals or cosmetics (e.g., extra outlets or nightlights) (Schreck et al. 1984).

16. Scientists have long disputed the efficacy of ultrasonic and electromagnetic pest repellers, citing inherent problems that negate their usefulness. Ultrasonic sound waves are highly directional, and are unable to penetrate or bend around solid objects such as cabinets, doors, furniture, appliances, walls, floors or ceilings. The waves are also rapidly absorbed by soft-textured materials such as cloth, paper, cardboard, and insulation. Consequently, they cannot reach cracks, crevices, voids, corners, and other protected places where most pests live (Koehler et. al 1986; Bomford and O’Brien 1990; Shumake 1995). Ultrasonic and electromagnetic emissions also diminish in intensity at short distances from the device, conflicting with manufacturer claims about their purported range of effectiveness (Gold et al. 1984; Wood 1986). Furthermore, animals tend to adapt and adjust to non-harmful sounds and stimuli in their environment. Any initial aversion to the sound is rapidly overcome. Habituation in response to ultrasound has been shown repeatedly with rats and mice, causing them to soon repopulate the avoided area, typically within hours, days, or a few weeks depending on conditions (Shumake et. al 1982; Howard and Marsh 1985; Corrigan 2011). Each of these points has been confirmed by testing of the Bell + Howell devices conducted by Ms. Feuerstein, the inventor of the devices.<sup>1</sup> Another significant limitation of ultrasonic devices is the need to be plugged into electrical

---

<sup>1</sup> Feuerstein Deposition pages 61-83.



outlets. Since electrical outlets occur at fixed locations (e.g. 12 inches above floor level), plug-in repellents often cannot be directed toward the specific areas where pests are living.

17. The retail packaging for the devices also acknowledges that “ultrasonic signals will lose intensity as it travels. It is also absorbed by soft objects such as carpeting and is reflected by hard surfaces such as furniture. Ultrasonic signals cannot reach nesting or feeding places behind walls, under floors or within cracks. ... In some cases, over time, certain rodents may become accustomed to ultrasonic signals. Some may return to their feeding or nesting areas even in the presence of an ultrasonic product.”<sup>2</sup>

18. Thus, even if some repellency effect of ultrasonic technology were theoretically observed in a laboratory setting, these limitations of ultrasonic technology would prevent devices from having any practical use in a real-world setting.

## **VII. TESTING AND ANALYSIS OF THE ELECTRONIC OUTPUT FOR BELL + HOWELL ULTRASONIC PEST REPELLERS**

19. According to Defendants’ testimony and documents, the Bell + Howell Repellers emit ultrasonic sound waves bearing a frequency of “40 kilohertz and plus/minus about five kilohertz,”<sup>3</sup> and amplitude levels at or around 88 dB.<sup>4</sup> Certain models also emit the sound waves at intervals.<sup>5</sup> Finally, at least one model also utilizes electromagnetic technology.<sup>6</sup>

20. In order to independently ascertain the ultrasonic and electromagnetic properties of the Bell + Howell devices, Plaintiffs commissioned the testing of two representative Bell + Howell devices by Dr. Richard Mankin, Research Entomologist with the U.S. Department of Agriculture, Agricultural Research Service, Gainesville, FL. Dr. Mankin has a background in

---

<sup>2</sup> Bates Number BHH,LLC006664.

<sup>3</sup> Feuerstein Deposition page 45.

<sup>4</sup> Bates Number BHH,LLC002959.

<sup>5</sup> Feuerstein Deposition page 25.

<sup>6</sup> Feuerstein Deposition page 73.

both entomology and physics and specializes in how pests sense and utilize sound. Dr. Mankin evaluated Ultrasonic Pest Repeller model #50167, and Electromagnetic/Ultrasonic Pest Repeller model #50153. The latter model is the only pest repeller featuring both “ultrasonic and electromagnetic technologies.” Findings are summarized below with additional details, including methods, attached hereto in Appendices 2 and 3.

21. During the evaluations, two of the Bell + Howell pest repellers (one of each type) malfunctioned and stopped producing signals. Output characteristics were based on the remaining functional units of each model.

22. Dr. Mankin’s evaluation on devices that did not malfunction found that the ultrasonic output of the two models was rather similar. Peak frequencies measured at a distance of 3 feet from Ultrasonic Repeller model #50167 ranged from 40.11 to 39.83 kHz (analysis of three different units), versus 37.50 to 36.14 kHz for Electromagnetic/Ultrasonic Repeller model #50153 (analysis of four different units). Sound pressure levels/amplitude of the respective devices ranged from 89.43 to 87.58 for model #50167, versus 99.30 to 96.21 for model #50153. These figures are consistent with levels reported in Defendants’ documents.

23. Dr. Mankin’s evaluation also found that sound output was static for Electromagnetic/Ultrasonic model #50153, whereas Ultrasonic model #50167 had a sweep frequency cycle varying from 55 kHz down to 38 kHz.

24. Dr. Mankin’s evaluation found that for both repellers, amplitude of the sound signal dropped appreciably on the other side of a ½ inch-thick corkboard panel placed 3 feet from the device (respective mean reductions of 26 dB and 18 dB for models 50153 and 50167). These results are consistent with Ms. Feuerstein’s testimony that her tests revealed that ultrasonic

signals were blocked by furniture.<sup>7</sup> As mentioned elsewhere in this report, other investigators have reported that ultrasound diminishes in the presence of obstructions.

25. Dr. Mankin also evaluated electromagnetic wave impulses for the Bell + Howell dual pest repeller model #50153. Variation in electromagnetic frequency (EMF) was measured 1, 2, 3, 6 and 12 inches from the device. He also measured electromagnetic frequency in comparison to the emissions of a small, 15-20W fluorescent light bulb. Dr. Mankin's evaluation found that electromagnetic output of the repeller was minimal, and not detectable at three or more inches from the device. The reading for the repeller was weaker than that of the fluorescent light bulb at the same distance. Previous scientific literature also reported weak magnetic fields associated with electromagnetic pest repellers, comparable to the emissions from many household appliances (Fitzwater 1978; U.S. EPA 1980).

26. Dr. Mankin's experiments affirm that pest repellers marketed by Defendants have electronic emissions similar to those already examined in other scientific literature. Devices reported on in the peer-reviewed literature produced waves of similar frequency (20-100 kHz), and amplitude (70-140 dB) as the Defendants. Some of these devices also emitted variable (e.g., sweeping) sound waves analogous to Bell +Howell's Ultrasonic Pest Repeller model #50167.

#### **VIII. TESTING OF BELL + HOWELL ULTRASONIC PEST REPELLERS SHOWS THE DEVICES TO BE INEFFECTIVE**

27. To investigate efficacy claims of the Bell + Howell repellers, Plaintiffs commissioned a series of experiments. Protocols were designed by me in collaboration with two of the top research labs that evaluate pest control products. Tests on cockroaches, ants, and spiders were performed by i2L Research USA, Baltimore, MD. Evaluations of rodents (mice)

---

<sup>7</sup> Feuerstein Deposition pages 63-72.

were performed by Sierra Research Laboratories, Modesto, CA. Full reports are provided in Appendices 4 and 5, with overall methods/results summarized below.

28. All experiments were conducted using the Bell + Howell Ultrasonic Pest Repeller model #50167, a unit extensively tested by Defendants and claimed to be effective (e.g., BHH, LLC 001531, BHH, LLC 001545, BHH, LLC 002531, BHH, LLC 002552, BHH, LLC BHH, LLC 2565, BHH, LLC 002594, FEUERSTEIN 000055, FEUERSTEIN 000074, FEUERSTEIN 000086). Previous testing of this repeller by Dr. Mankin indicated peak frequency/amplitude levels of 40 kHz/88dB, with a sweep frequency cycle varying from 55 kHz down to 38 kHz. These specifications are similar to those reported by Defendants (see paragraph 19), and are representative of other ultrasonic devices evaluated in the scientific literature (see Chart, Section IX-E).

#### **A. Insect and Spider Tests (Methods)**

29. Bell + Howell's Ultrasonic Pest Repeller was evaluated in separate trials against three of the most common household pests: German cockroaches, *Blattella germanica*; odorous house ants, *Tapinoma sessile*; and cellar spiders, *Achaeearanea tepidariorum*. (NPMA 2014).<sup>8</sup> Units tested were the same ones examined (and found to be operational) by Dr. Mankin.

30. Test arenas consisted of paired plywood enclosures with a Plexiglass front (3x3x3 ft. total dimension). The two-chambered enclosures were connected by a tubular cardboard conduit to allow pests to move freely between sides. Treated enclosures were outfitted with a repeller mounted to the top-center of one side, with the speaker facing downward (i2L Efficacy Report, Figures 1-2). Three paired enclosures armed with a repeller served as treatments, while

---

<sup>8</sup> NPMA Field Guide to Structural Pests. 2014. Fairfax, VA.

three similar setups without a repeller served as untreated controls. Prior to treatment, both sides of each enclosure were provisioned with food (dog food for the cockroaches; a cotton ball saturated with 10% sucrose solution and dead flies for the ants; live cockroaches for the spiders).

31. For the cockroach test, a tubular cardboard harborage containing 100 mixed-stage nymphs and adults (per replicate) was introduced on the side of enclosures with a repeller. A similar cardboard harborage with no cockroaches was placed on the side without repeller. The reason for including harborage was to simulate a more natural environment during the study. Cockroaches are cryptic pests which aggregate in cracks, voids, and other protected locations within dwellings.<sup>9</sup> Confining the insects in a chamber devoid of harborage (as in tests conducted by Defendants) creates an unnatural environment that would further alter their behavior. After two initial 24-hour acclimation periods, the repellents were turned on continuously for 10 consecutive days. Visual counts of the number and location of cockroaches in treated and untreated (control) enclosures were made on day 0 (pre-device activation), 1, 3, 5, and 10 (post-activation).

32. For the evaluation against ants, 100-150 workers (per replicate) were introduced on the side of the enclosures with the repeller. Artificial nesting chambers (small plastic dishes with perforations and a plaster bottom) served as a harborage and facilitated transfer of ants into enclosures (i2L Efficacy Report, Figs. 3-6). Similar to cockroaches, ants maintain their nests in hidden locations to help protect the colony. Provisioning the test enclosures with a small nesting harborage afforded a more natural condition to monitor ant behavior. Location of ants was then

---

<sup>9</sup> Cornwell, P.B. 1968. *The Cockroach*. 391pp. Hutchinson & Co. London.

recorded for 7 days after repellents were activated in a similar manner as described for cockroaches.

33. Similar methods were used to evaluate repellent effects on spiders. Fifteen adult cellar spiders were introduced per enclosure on the side with the repeller. Cellar spiders are solitary and therefore do not aggregate or live in communal nests like cockroaches or ants. In dwellings, they tend to reside in corners of rooms, along baseboards, etc. Consequently, no supplemental harborage was added when spiders were introduced into the enclosures. Location of spiders was recorded for 6 days after pest repellents were activated as described earlier for ants and cockroaches.

#### **B. Insect and Spider Tests (Results)**

34. Most cockroaches, ants and spiders remained on the enclosure side with the repeller, indicating little if any effect on simulated infestations just a few feet from the device. After 10 days of constant, 'point-blank' exposure, only 13% of cockroaches overall were found on the opposite, untreated side of the enclosure. Virtually all of this movement occurred in one replicate, yet still demonstrated less than 40% movement in respect to the control. In the other two replicates, almost no cockroaches (0% and 2%) moved to the side opposite the repeller (i2L Efficacy Report, Results Table 2; Figure 1).

35. Minimal directional movement away from the repeller occurred with spiders. The greatest movement to the non-repeller side relative to the untreated control occurred on day 3 (only 6.8%). By day 6, net movement of spiders away from the repeller side was zero ((i2L Efficacy Report, Results Table 2; Figure 2). Throughout the trial, spiders continued to reside on ceilings and in corners in areas with the repeller, occasionally capturing and feeding on live cockroaches provided as food.

36. There was also negligible repellence of ants. After 7 days of continuous exposure, not a single ant was found on the non-repeller side of the enclosure ((i2L Efficacy Report, Results Table 2; Figure 3). The fact that cockroaches and ants tended to remain on the side where first introduced was likely aided by aggregating factors (e.g., pheromones) associated with the supplied harborage. Cockroaches and ants deposit pheromones in harborage locations within dwellings. This results in ‘aggregations’ (with cockroaches) and ‘nests’ (with ants).<sup>10</sup> To have any chance of “driving cockroaches and ants out of homes and buildings,” the Bell + Howell devices would need to repel them out of such locations. This experiment clearly shows they do not.

37. In summary, the investigators concluded that “the Bell+Howell Repeller #50167 ultrasonic device was not effective at repelling cockroaches, spiders, or ants during the trial duration.”

### **C. Rodent Tests (Methods)**

38. Bell + Howell’s Ultrasonic Pest Repeller was also evaluated against rodents, specifically the house mouse, *Mus musculus*. Mice are by far the most common rodents in residential settings (Corrigan 2001), and therefore the logical pests on which to test these devices. Although we did not test the Bell + Howell pest repeller against rats, there is no scientific basis for them to perform differently than mice under the conditions of the testing. Both rats and mice are capable of hearing ultrasonic sounds. Mice can hear within a range of up to 90 kHz, while rats can hear up to 100 kHz (Corrigan 2011). Previous studies that tested

---

<sup>10</sup> Handbook of Pest Control (2011). Cleveland, OH

identical ultrasonic devices on both rats and mice found them to be ineffectual against both types of rodents (Sprock et al. 1967; Shumake 1984).

39. Rats and mice are highly developed mammals with complex behaviors. Exposing these wary animals to an electronic device in a small, confined, empty plastic chamber has little relevance to how they would react in a building or residential setting. The current study, designed on behalf of Plaintiffs, was developed in consultation with Dr. William Donahue (Sierra Research Labs) who conducted the trial, and Dr. Robert Corrigan (RMC Pest Management Consulting), one of the worlds' leading experts on rodents and their management, with the intent of closely simulating real-world conditions.

40. Six vacant apartments in Modesto, CA were selected for the experiment. The apartments were divided into two groups of three apartments: untreated controls (no repellents) and treated (B&H Ultrasonic Pest Repeller # 50167). Each group consisted of one, 1-bedroom apartment and two, 2-bedroom apartments. Utilities (electricity) remained on for the duration of the evaluations.

41. Wild house mice, *Mus musculus*, collected from a commercial poultry facility were used in the study. Before being released into the apartments, the mice were acclimated in the lab for 1-2-weeks and any unhealthy individuals were removed. Several age classes and a mixed sex ratio were represented by the collections.

42. Each apartment was modified to minimize escape of introduced mice. Kitchen and bathroom areas had masonite™ panels installed to keep mice out of cabinets with plumbing fixtures and appliances since the pipes, drains, electrical and clean-outs are shared by adjoining apartments. A barrier panel was also placed around the front door to prevent escapes when the exterior doors were opened for the daily census counts. Mice are wary, mostly nocturnal



mammals that make their nests in concealed locations (Meehan 1984). Since the study was conducted in vacant apartments partitioned by unclimbable Masonite™ panels, supplemental harborage was needed to afford safe nesting and feeding sites for the mice. Multiple harborages were necessary due to the fact that mice are often territorial. Four harborage boxes were placed into each apartment, two in the front of the apartment and two in the back bedroom. The harborages were constructed of empty (new) rodent bait stations covered by an inverted cardboard box with holes cut in two of the four sides so mice could enter the box and rodent station within. The dual box configuration served as a secure nesting and harborage site, which the mice readily utilized in the otherwise unprotected confines of the apartments. Wood shavings and cotton balls were provided as bedding and nesting materials for the mice to utilize as they would naturally. Three plastic dishes of food (cat chow and rodent chow) and one dish of fresh water was placed into the front room of each of the six apartments and refilled as necessary. The hallway leading to the back “escape” room was blocked off during the pre-treatment phase so that mice acclimated to front rooms of each apartment.

43. Two Bell + Howell ultrasonic pest repellers were plugged into the wall sockets in the front room of each treated apartment. The units were checked for operation as indicated by the flashing red light on each unit. Two cameras were also installed in each apartment, one positioned to capture images in the front room (where the repellers were located), and a second camera in the back bedroom to capture mouse movement away from the repellers. Figures 1 and 2 of the full report (appendix 5) show a schematic of the one and two-bedroom apartments modified to contain mice and location of repellers, harborage, food, water, etc. Untreated (control) apartments were configured in the same way minus inclusion of repellers.

44. Once installation was completed, 12 mice were released into the front room of each apartment and allowed to acclimate for one week. Each apartment was checked twice daily for mouse activity and status of food, water and harborage. The repellents were turned on mid-afternoon on test day 0 to start the efficacy evaluation within the units. The exclusion panel was removed from the hallway to allow the mice free access of the entire apartment as modified. Additionally, the back-room doors were cracked open approximately 1" to allow access to the "escape area" with the two boxes affording additional nesting and harborage. The trail cameras were activated at the same time to record mouse movement and activities during the 14-day evaluation period.

45. Mouse locations were monitored visually in each apartment twice a day for 14 days. Counts were made in all four nesting/harborage boxes located in the front and back rooms. Mouse locations were also noted for individuals not in the boxes, but freely moving or hiding in other areas within each apartment. Although not always possible, attempts were made to account for all 12 mice in each apartment with minimal disturbance to the mouse populations. The trail cameras were utilized to record mouse activity throughout the day and night and maintain a digital record of the activity at the front and back of each apartment. The images were utilized to provide an activity rating of mouse activity and behavior.

#### **D. Rodent Tests (Results)**

46. Mice were very active in both treated and untreated (control) apartments as indicated by visual counts, utilization of food, water and nesting materials, and urine and fecal deposits within the unit. Mice were actively moving resources into the nesting/harborage boxes, and food and nesting materials were constantly being moved around. Based on these aggregate observations, most of the activity was in the front rooms of both the treated and control apartments.

47. The visual mouse counts revealed that mice immediately began to explore the whole apartment and use the “mouse stations” (boxes) in both locations within each apartment. In the untreated apartments, the visual counts demonstrated an even distribution of the mice between the front and back rooms. The distribution of mice was approximately 50:50 over the 14-days of the evaluation (Full report, Figure 3). Statistical analysis of data for week 1 and week 2 indicated that for each week, the mice were evenly distributed between the front and back rooms (Full report, Table 1). Additional observations, however, indicated that most of the mouse activity remained in the front room where the mice were first acclimated. Food and nesting materials were transported from dishes and boxes throughout the front room, but to a much lesser extent in the back room. Urine and droppings were also concentrated in the front room of the untreated control apartments with far less evidence in the back rooms.

48. The apartments where the Bell + Howell Ultrasonic Pest Repellers were placed showed a slightly different mouse distribution pattern from week 1 to week 2. The visual mouse counts initially indicated about 70% of the mice in the back room and about 30% in the front room where the two repellers were plugged into wall sockets. For the first 5 days the mouse distribution was unequal, but began to equilibrate from day 5 through day 14 to about a 50:50 distribution as was observed in the untreated control units (Full report, Figure 4). This distribution suggested the Bell + Howell Ultrasonic Pest Repellers were influencing mouse distribution for the first week of the evaluation, but not in the second week, a finding supported by statistical analysis of the data (Full report, Table 2).

49. Observations in the Bell + Howell Ultrasonic Pest Repeller treated apartments again indicated that most of the mouse activity remained in the front room where the mice were initially acclimated. Bedding material and food were transported from the dishes and stations

throughout the front room, but only a small amount of food was transported to the back room. Urine and feces were also concentrated in the front room (where the repellents were installed), with far less evidence in the back rooms where no repellents were present.

50. The trail cameras showed extensive mouse activity in both the treated and untreated apartments. Several images captured mice investigating the Bell + Howell Ultrasonic Pest Repellers and at least one image showed a mouse sitting on top of the repeller plugged into the wall:



There did not appear to be activity or behavioral differences in the mice between the repeller treated apartments and untreated control apartments.

51. The investigators concluded that while the Bell + Howell Ultrasonic Pest Repellers had a slight initial effect on house mouse distribution, by the second week just as many mice were observed in rooms with devices as without. Moreover, mouse activity (as indicated by presence of droppings, urine, nesting materials, etc.) appeared identical between the treated and

untreated apartments demonstrating no discernable differences attributed to the repeller. The findings are consistent with previous scientific research on rodents and ultrasonic devices (Section IX, D.) — any initial aversion to such sounds being temporary, followed by resumption of normal activities.

**IX. TESTING OF COMPARABLE DEVICES SHOWS THAT THE ULTRASONIC AND ELECTROMAGNETIC TECHNOLOGY USED IN THE BELL + HOWELL DEVICES IS INEFFECTIVE**

52. In addition to tests of the Bell + Howell devices commissioned by Plaintiffs, a great wealth of literature studying the technology used by the devices supports my conclusions that the devices are ineffective for their stated purposes.

53. During the past 45 years, ultrasonic and electromagnetic devices have been evaluated against an assortment of pests, including mice, rats, chipmunks, possums, snakes, cockroaches, ants, spiders, termites, mosquitoes, fleas, and bed bugs. In almost all cases, the independent investigators found little if any biological effect warranting utilization for pest control. Consequently, regulatory bodies have taken repeated enforcement actions against manufacturers of these devices (U.S. EPA 1980; Shumake 1995; U.S. Federal Trade Commission 2001, 2003). Summarized below are peer-reviewed studies conducted on cockroaches, ants, spiders, mice and rats — the five principal pests claimed to be controlled and driven out of homes and buildings by Defendant's products.

54. The prevailing scientific literature has repeatedly demonstrated that devices with the same characteristics as the Bell + Howell devices are ineffective in controlling pests and driving them out of buildings. As Ms. Feuerstein, the inventor of the devices has indicated, the Bell + Howell devices were themselves modeled after other brands' ultrasonic pest repelling devices. Ms. Feuerstein also understood that although different products may bear different brand names or casing designs, the ultrasonic sound waves they emit may still be effectively

identical.<sup>11</sup> Thus, inferences regarding the effectiveness of the Bell + Howell devices may be reliably drawn from studies measuring the effectiveness of other devices bearing the same ultrasonic and/or electromagnetic properties, as detailed below.

**A. Cockroaches**

55. Several independent, peer-reviewed studies have evaluated the effects of ultrasonic and electromagnetic devices on cockroaches. Paired enclosures connected by a conduit were often employed allowing cockroaches to move freely from one side to another in the presence or absence of the electronic device.

56. In choice box experiments, German cockroaches, *Blattella germanica*, exposed to static ultrasonic frequencies of 20, 30, 40, 50, and 60 kHz displayed no behavioral avoidance or repellency (Ballard and Gold 1982, 1983). In a similar study with a commercial device producing variable ultrasound (30 to 65 kHz at intervals of 1.8 to 4 times per second), the researchers observed a temporary increase in cockroach movement, but after one week the roaches were no longer affected leading them to conclude that the effects were biologically unimportant (Ballard et al. 1984).

57. In an investigation conducted at the request of the Federal Trade Commission, Gold et al. (1984) tested four different brands of ultrasonic devices with different frequencies (20-50 kHz), amplitudes (100-137 dB), and pulse durations (2-14 msec). Conclusions were that manufacturer claims of controlling, repelling, and eliminating cockroaches were unfounded. The researchers also found that output frequency diminished rapidly away from the ultrasonic devices, and that a thin (0.3 cm) piece of cardboard attenuated output by over 60 percent.

---

<sup>11</sup> Feuerstein deposition page 19.

58. In related laboratory work with paired enclosures, Schreck et al. (1984) evaluated and determined that another commercial ultrasonic device was ineffective in repelling or eliminating German cockroaches, even after 90 continuous hours of operation. The device had peak ultrasonic frequencies of 44 and 53 kHz with pulse durations of 7.6 and 14.2 msec, and amplitude of 96 dB at 0.5 meters from the transducer. The researchers further concluded that: “There is no reason to expect a different effect on these insects if they were exposed to other ultrasonic devices having similar frequency outputs.”

59. A more recent study (Ahmad et al. 2007), evaluated random ultrasonic sound patterns to see if they would improve repellency against mosquitoes and the German cockroach. Ultrasound in the 20-100 kHz frequency, and 91-102 dB amplitude range failed to repel either pest, mirroring previous negative findings with commercial devices producing constant sound patterns.

60. Three other ultrasonic devices with varying frequencies and amplitudes (26-34 kHz/ 95 dB; 27-35 kHz/ 92 dB; 28-42 kHz/ 88 dB) were evaluated for their effects on German cockroaches (Huang and Subramanyam 2006). The investigators found a lack of repellency to all three devices and concluded that: “Ultrasonic technology could not be used as an effective pest management tool to repel or eliminate the German cockroach.”

61. Koehler et al. (1986) evaluated nine additional commercial ultrasonic devices against German cockroaches in paired unfurnished rooms. Ultrasonic output of the devices varied considerably with most producing two distinct and alternating high frequency sound outputs ranging from 17 to 71 kHz and 51-103 dB. Irrespective of the output characteristics of the device, cockroaches were just as likely to enter a room treated with ultrasound as a similar untreated room. In fact, a numerically greater percentage of cockroaches were found in the

ultrasound-treated rooms than the untreated rooms, reinforcing the lack of repellency of the devices. Additional trials by the researchers showed that ultrasound was ineffective in reducing infestations of German cockroaches in occupied apartments. Infested apartments were treated by placing a commercial ultrasonic device in the dining area pointing directly into the kitchen. Additional apartments were left untreated as controls. Weekly cockroach counts showed no significant decline throughout the 10-week treatment period. By week seven, cockroach numbers had nearly doubled compared to pretreatment levels, and by week 10, tenants were so dissatisfied they wanted the devices removed. Some of the retrieved ultrasonic units were later found to have cockroaches harboring inside the device (presumably attracted to the warmth), underscoring the lack of effectiveness in repelling and controlling cockroaches.

62. A similar lack of success in ridding dwellings of German cockroaches with commercial ultrasonic devices was noted by Gold (1995). No significant reductions occurred during a two-week (1986) study that they conducted in cockroach-infested dormitories on the campus of Texas A&M University.

63. By inserting microelectrodes into the sensory nervous system of American cockroaches (*Periplaneta americana*), another household-infesting species, Decker et al. (1989) determined that the insects responded to sound frequencies from 100 to 3200 Hz (within the audible range for humans), but did not respond to sound emitted from 10,000 to 40,000 Hz/10-40 kHz (ultrasonic ranges). The finding led the researchers to surmise that ultrasound had no potential or utility for controlling cockroaches.

64. In 1977, the U.S. Environmental Protection Agency initiated an extensive investigation to determine if electromagnetic pest repellers were effective in controlling various pests including cockroaches (U.S. EPA 1980). Scientists at the University of California



Riverside evaluated three commercial electromagnetic devices both in laboratory studies and cockroach infested apartments (Rust et al. 1980). No differences in avoidance or movement occurred when German cockroaches were exposed to any of the electromagnetic devices. The devices also had no effect on cockroach propagation or efficacy of insecticides. Additionally, none of the three electromagnetic devices had any benefit in reducing cockroaches in infested apartments. Instead, populations doubled or tripled compared to when the devices were first installed 12 weeks earlier—the same level of increase in apartments where no treatment was performed. By comparison, a single application of either of two commercial insecticides provided greater than 90% reductions in apartments over the same period. A similar lack of discernable effects on termites and flour beetles led the researchers to conclude that electromagnetic devices probably would have negligible effect on other household insects as well.

## **B. Ants**

65. Scientific studies have likewise shown a failure of ultrasound to repel and control ants. Huang et al. (2002) conducted laboratory and field trials with three commercial devices with varying frequencies and sound pressure levels (26-34 kHz/ 95 dB; 27-35 kHz/ 92 dB; 28-42 kHz/ 88 dB). Colonies of three common species of carpenter and field ants (*Camponotus pennsylvanicus*, *C. festinatus*, *Formica pallidefulva*), were released into paired interconnected enclosures with and without an ultrasonic pest repeller. None of the three species of ants were repelled from enclosures containing active devices. In another series of experiments, the ultrasonic devices were installed within 2 feet of metal trashcans provisioned with food debris to attract ants. After 10 days of continuous operation, none of the three ultrasonic devices significantly reduced the number of ants foraging on and within the trash containers.

66. In another field study, Warner and Scheffrahn (2005) evaluated an ultrasonic pest repeller and various insecticides for control of white-footed ants (*Technomyrmex albipes*). Five boxes containing ants and brood were arranged in a semi-circle with three ultrasonic repellers stationed about one foot away. After 51 days of continuous operation, ants in three of the five boxes moved to nest against a box wall closer to the repellers, causing the investigators to conclude the repellers were ineffective in repelling or controlling the ants.

### **C. Spiders**

67. Other studies have evaluated effects of pest repellers on spiders. Two commercial ultrasonic devices with varying frequencies and amplitudes (26-34 kHz/ 95 dB; 28-42 kHz/ 88 dB) were evaluated against longbodied cellar spiders (*Pholcus phalangioides*), one of the most common household spiders in the U.S. (Subramanyam 2003). No effect on movement or repellency was observed when groups of spiders were introduced into 4x4x4-ft. paired interconnected enclosures with either ultrasonic device.

### **D. Rodents**

68. Numerous studies have evaluated the effects of ultrasonic and electromagnetic pest repellers on rodents (Sprock et al. 1967; Meehan 1976; Lavoie and Glahn 1977; Fitzwater 1978; Beck and Stein 1979; Lund 1984; Shumake et al. 1982, 1984; Howard and Marsh 1985; Bomford and O'Brien 1990; Koehler et al. 1990). While in some instances rats or mice were repelled from the immediate area of sound for a brief period, they soon returned and resumed normal activities. Essentially all of the independent investigators rejected the devices as a practical means of rodent control and concluded they were unlikely to control, repel, or drive rodents out of homes or buildings. As summed up by Koehler et al. (1990), "There have been so many failures reported with high-frequency sound that little can be said in favor of such devices."

69. Sprock et al. (1967) conducted a series of laboratory and field experiments with equipment producing sounds in the sonic/ultrasonic range of 1.8- 48 kHz and 60-140 dB. To quote the researchers: “In our experiments, ultrasonics did not repel rats and mice from any of the tested areas... Eight years of evaluation of basic principles inherent to the use of acoustical frightening devices produced only negative results. None of the combinations tested will effectively extirpate rodents from a storage building by stimulating their receptors”

70. Lavoie and Glahn (1977) analyzed sound output of five commercial ultrasonic devices claimed to be effective in driving rodents from buildings. Signal frequencies/amplitudes for the devices ranged from 22-50 kHz and 87-112 dB. Two contrasting types of devices were then selected for field testing against Norway rats (*Rattus norvegicus*) — one producing a wide band of frequencies (19-50 kHz) with an amplitude of 87 dB, the other with narrow frequency (22 kHz) but higher amplitude of 112 dB. Twenty rats were introduced into two adjoining rooms in the basement of an unoccupied warehouse, one with and one without the device. Consumption of food was then monitored at several locations within each room over two 3-week periods. Rats fed continuously in the presence of both devices, causing the researchers to conclude, “Neither ultrasonic device would be effective in expelling Norway rats from warehouses or preventing them from taking food, even quite close to the sound source.”

71. Shumake (1984) evaluated six additional commercial ultrasonic pest repellers in a series of field experiments involving wild Norway rats and field mice. Enclosures ranged in size from 8.9 to 196.5 m<sup>2</sup> and consisted of metal, wood or brick construction with concrete or earthen floors. Output characteristics of devices included fixed, random and continuous sweep frequencies ranging from 20-100 kHz and intensities/amplitudes of 78-122 dB. The investigators observed only occasional, temporary repellent effects. “Despite the wide range of decibel levels

and frequencies evaluated, strong, sustained repellent effects were never detected...the six devices had insufficient repellency to merit any usefulness in rodent pest control applications, preventive or corrective” (Shumake 1995).

72. University of California, Davis scientists W.E. Howard and R.E. Marsh began evaluating effects of ultrasound on rodents in the late-1950s. In a review 30 years later, they concluded: “It is well established that such (ultrasonic) devices will not exterminate, kill, or drive rodents out of a favorable habitat. At best, they may temporarily discourage rodents from visiting areas in buildings that have little cover available... most rats and other rodents quickly become accustomed to any new sound, especially after it has been repeated long enough. Consequently, rats and mice can be found living in grain mills, machine shops, around airports, along major highways, and many other places where the sound frequencies and levels of intensity are highly varied and complex.” (Howard and Marsh 1985).

73. Rentokil, the largest pest control company in Europe, evaluated 20 different ultrasonic devices with varying outputs against rats and mice in indoor and outdoor experimental situations as well as in practical field trials. The investigators concluded, “None of the units produced anything more than a partial repellency for a day or so which was overcome, regardless of whether the frequency was variable, random, or intermittent” (Meehan 1984).

74. Scientists with the Danish Pest Infestation Laboratory Ministry of Agriculture tested 11 different ultrasonic devices with varying frequencies, amplitudes (100-130dB), and random intervals between emissions. Norway rats were housed in 14 by 14-foot interconnected rooms, each provisioned with food, water and straw for nesting. One of the rooms had a device pointing directly at the feeding tray, while the other room did not. The investigators deemed the setup “most favorable from the producer’s (manufacturer) viewpoint, since it was a small area

with no obstacles to create sound shadows.” Although in some cases rats were initially disturbed by the sound, they soon became accustomed (within 3 hours of switching on the device), and showed no signs of repellency for the remaining 7 days of the experiment. The researchers concluded that the findings “strongly indicate that a practical effect in a warehouse, stable, store room, or almost any other building is out of the question” (Lund 1984, 1988).

75. In the late-1970s, the U.S. EPA also contracted with scientists to determine if electromagnetic pest repellers were effective in controlling rats and mice. The National Bureau of Standards performed electronic analyses of 15 different commercial devices having two types of outputs; a pulse output, with no significant external electromagnetic field, or a 60 Hz AC output that generates a detectable magnetic field. Although emissions at 3 meters or more from the devices were determined to be less than the earth’s magnetic field, three were selected for subsequent evaluation against rodents. Laboratory and field studies conducted by rodent experts at the University of California Davis found no significant effects on growth, development or behavior of either wild house mice or wild Norway rats, leading them to conclude that all were ineffective against rodents (Marsh and Howard 1980). Scientists at EPA’s Animal Biology Laboratory, Beltsville, MD also reported negligible effects on rats exposed to four different electromagnetic repellers (Palmateer 1980). Consequently, the Pesticides and Toxic Substances Enforcement Division of EPA executed enforcement actions against all manufacturers and distributors of such devices on the basis that low-level electromagnetic emissions were ineffective against rodents and other household pests (U.S. EPA 1980). Controlled studies by others led to similar conclusions with little objective support for their use in pest control (Fitzwater 1978).

76. Each of the essential texts used by the pest management industry advises against using ultrasonic and electromagnetic devices and deems them ineffective. Often considered the ‘bible’ of pest control, the *Mallis Handbook of Pest Control* states: “Despite a history of 35 years of availability and use, the overwhelming majority of the professionals in the pest management industry on a global scale have failed to embrace ultrasonic devices, even as a supplement to conventional rodent control programs. Certainly, this reluctance cannot be written off as an oversight by on-the-job professionals.” Similar lack of effectiveness was indicated for electromagnetic devices (Corrigan 2011). Another seminal resource of pest professionals is the *Truman’s Scientific Guide to Pest Management Operations*. Opining on such devices it states: “Many types of electrical or mechanical devices are marketed for pest control, including electromagnetic, sonic, ultrasonic, micro-vibrational and electromechanical devices. To date, no valid scientific studies have shown any of these devices to be effective at repelling, sterilizing, killing or otherwise affecting cockroaches or their behavior in a way that can be used effectively in a management program.” (Bennett et al. 2010).

77. Dr. Robert Corrigan, the nation’s leading expert on rodent management, concurs that research and experience do not support the use of such devices. “Considering the seriousness of some residential rodent invasions (fires due to gnawing, Hantavirus and other disease transmission, asthma attacks of children, etc.), the monies spent on such unproven devices could be better directed toward dependable, effective tools or the services of a pest professional” (Corrigan 2001). Similar criticisms of electronic pest repellers are expressed in *Advances in Urban Pest Management*: “There are no indications that ultrasonic devices, as a single or lone method, will control rodents, and regardless of the desire for a ‘magic bullet,’ ultrasonic devices are useless for the control of insect pests” (Wood 1986). Such devices are also panned in

*Common Sense Pest Control*, with a bent toward non-chemical measures: “Although no technique should be overlooked in pest control, one should not expect panaceas, either. The appeal of repellent sound devices is their apparent simplicity. You plug in the machine and the rodents go away. As with other simple solutions to complex problems, you should retain a sense of skepticism” (Olkowski et al. 1991). The pest management industry is in the business of preventing pests in order to retain customers. Many of their clients are also averse to pesticides. If ultrasonic/electromagnetic pest repellers had any benefit in controlling or preventing pests, professionals would be keen to include them in their service. In 30-plus years of working with the professional pest management industry, I cannot recall a single instance of a company, large or small, willing to risk their reputation on these ineffectual devices.

**E. Summary of Studies**

78. The below chart summarizes the studies cited herein on the efficacy of ultrasonic technology. As reflected in the chart, the devices studied all used technology with the same or very similar properties (frequency, amplitude, pulse variation) to the Bell + Howell devices at issue.

[remainder of page left intentionally blank].

STUDY	PEST TESTED	FREQUENCY	AMPLITUDE	VARIABLE/PULSATING	TEST RESULT
Ballard and Gold (1982, 1983)	Cockroaches	20-60 kHz		No	Failed
Ballard et al. (1984)	Cockroaches	30-65 kHz		yes	Failed
Gold et al. (1984) (FTC)	Cockroaches	20-50 kHz	100-137 dB	yes	Failed
Schreck et al. (1984)	Cockroaches	44-53 kHz	96 dB	yes	Failed
Ahmad et al. (2007)	Cockroaches	20-100 kHz	91-102 dB	yes	Failed
Huang and Subramanyam (2006)	Cockroaches	26-42 kHz	88-95 dB	yes	Failed
Koehler et al. (1986)	Cockroaches	17-71 kHz	51-103 dB	yes	Failed
Gold (1995)	Cockroaches				Failed
Decker et al. (1989)	Cockroaches	10-40 kHz		no	Failed
Huang et al. (2002)	Ants	26-42 kHz	88-95 dB	yes	Failed
Warner and Scheffrahn (2005)	Ants				Failed
Subramanyam (2003)	Spiders	26-42 kHz	88-95 dB	yes	Failed
Sprock et al (1967)	rats and mice	1.8-48 kHz	60-140 dB		Failed
Meehan (1976)	rats	varying	varying	yes	Failed
Lavoie and Glahn (1977)	Rats	19-50 kHz	87-112 dB	yes	Failed
Shumake et al. (1984)	Rats and mice	20-100 kHz	78-122 dB	yes	Failed
Howard and Marsh (1985)	rats and mice	varying	varying	yes	Failed
Lund (1984, 1988)	Rats	varying	100-130 dB	yes	Failed
<b>Bell + Howell Repellers</b>		<b>36-40 kHz</b>	<b>88-99 dB</b>	<b>certain models</b>	

## X. DEFENDANTS' FLAWED EXPERIMENTS YIELD FALSE CONCLUSIONS

79. I also reviewed efficacy tests conducted on pest repellers marketed by Defendants (Bell + Howell models 50153, 50161, 50165, 50167, 50179, 50183). All tests were contracted through Intellitec International and performed by labs in China. The setup for most trials consisted of two plastic 4 (L) x 4 (W) x 1.5 (H) foot chambers connected by a curved plastic tunnel. The device was placed into one chamber to assess whether pests were repelled to the other. Cockroaches, ants, spiders, mice, and/or rats were placed into chambers and allowed to acclimate for a few days, after which the device was turned on. Records were then kept for one week on where pests were located in relation to the repeller, and amount of food and water consumed in each chamber.



80. Several problems with the design and conduct of these experiments led to erroneous conclusions. No replication, randomization, or statistical analysis of the data were performed in any of the tests, making it hard to know whether observed differences were real or random. Small sample sizes — in some instances fewer than 10 specimens for the entire experiment— are wholly inadequate. The lack of untreated experimental controls also prevented drawing meaningful conclusions. Since none of the trials were randomized or replicated, contractors based their conclusions on a single unit for the entire experiment.

81. No specifics were provided on the species of insects, spiders or rodents evaluated, an odd omission for any study involving biological organisms. Also troubling was the contractor's practice of placing two or more types of pests into the same set of chambers at the same time (e.g., BHH, LLC 000713, 001810 - mice, spiders and cockroaches; BHH, LLC 001545, 002552, FEUERSTEIN 000074 - spiders, ants, and cockroaches; BHH, LLC 001863, 002531 – ants and cockroaches). Since mice eat cockroaches and spiders, and certain spiders prey upon cockroaches and ants, perceived repellency could have been from avoiding predators rather than the device. Intents to sustain spiders on a diet of bread and granulated sugar (BHH, LLC 002531, 002552) raises further questions about the aptitude of those performing these studies.

82. Poor test design yielding invalid results also was the case with rodents. In contrast to insects and spiders, rats and mice are mammals with complex behaviors. Most of the rodent tests utilized the same 4 x 4 x 1.5 foot plastic chambers employed for cockroaches, ants, and spiders — an exceedingly small space to conduct experiments of this nature (Bomford and O'Brien 1990; Shumake 1995). Confining 10 to 20 rats or mice in such a small space stressed and altered the normal behavior of the rodents. This was apparent from the mortality experienced

in most trials: BHH, LLC 001508 - 2 dead rats, 1 dead mouse on the day before the device was activated; BHH, LLC 001421 – 3 dead rats, 2 dead mice before device was activated; BHH, LLC 001531 - 3 dead rats, 3 dead mice; BHH, LLC 001750 – 2 dead rats, one dead mouse the day before activation; BHH, LLC 002509 – 2 dead rats before activation; BHH, LLC 002593 – 1 dead rat, 1 dead mouse before activation; FEUERSTEIN 000086 – 9 dead rats (3 before and 6 during activation), and 7 dead mice (2 before and 5 during activation). Comments in some of the reports asserting there were “*no ethical issues involved (sic) observation of animals/pests carrying out their natural or normal behaviors,*” underscores a fundamental lack of understanding about rodent behavior/experimental design by the contractors.

83. Rats and mice are cautious and tend to avoid strange objects in their environment. In all of the rodent trials, a single electronic device was placed in one of the paired chambers. As in the tests with cockroaches, ants, and spiders, the lack of replication and experimental controls allowed for inherent bias favoring one chamber over another due to such factors as differing air currents, light intensity, temperature — or the presence of a strange object in a small confined space.

84. Another troubling aspect of the experiments involved the “preliminary testing” before activation of the device. According to the investigators, the two-day preliminary interval was “to ensure the test apparatus and the selected food functioned properly.” Peer-reviewed studies of a similar nature indicate that the actual purpose of pre-treatment monitoring is to allow test animals to acclimate to their new surroundings and establish a baseline compared to with the activated device (Bomford and O’Brien 1990; Shumake 1995). No acclimation period whatsoever was afforded to rats and mice added during most trials due to stress-related mortality (e.g., BHH, LLC 001545, 001810, 002509, 002593). Test reports further suggest that after the

pre-activation period, rats and mice were subsequently *re-released* into the chambers— negating the purpose of such monitoring. (Rodents should have remained in the chambers continuously before, during, and after activation of the device.).

85. Investigators asserted that any pests that “stayed” in a chamber without a device were considered repelled, while any remaining in chambers with a device were not repelled. They based this assumption on a visual count taken once per day; it does not consider where pests were located throughout the previous 24-hour period. Daily measurement of food and water consumed suggested sustained movement of pests between chambers with and without a device. In test document BHH, LLC 000713, the reduction in total food weight during the activation period was numerically *higher* in the room with the repeller (Room 3; 1.9 ounces), than in four of the five other interconnected Rooms 1, 2, 4 and 5 without the repeller (1.7, 1.7, 0.9, and 1.1 ounces). The remaining room without the repeller had a total food weight loss of 2.1 ounce. Continued movement between chambers based on consumption of resources was also evident in test document BHH, LLC 001422. Although fewer rodents were counted in the chamber with the repeller, appreciable amounts of food and water were still consumed — for rats, a daily average of 78 g of food and 179 ml of water on the side with the repeller, versus 114 g and 228 ml on the side without the repeller. For mice, 26 g and 29 ml of food and water were consumed on the side with the repeller, versus 29 g and 44 ml on the side without repeller. Daily back and forth movement of pests as shown by continued consumption of resources in both chambers was also apparent in other tests (BHH, LLC 001509, BHH, LLC 002593, BHH, LLC 002640, FEUERSTEIN 000055). The fact that this occurred even on days when no pests were observed in the chamber with the device suggests such movements may have been occurring at night.

86. Photos accompanying some test reports indicate that white laboratory mice were used in the experiments (e.g., BHH, LLC 000713, 001750, FEUERSTEIN 000086). Years of inbreeding have radically changed lab-reared mice from their wild ancestors, causing them to have different physiology and behavior. Consequently, they should never be used to predict performance of pest control products in the field.

87. None of the devices were tested in conditions that would accurately predict their effectiveness in driving pests out of a home. The small 4 x 4 x 1.5 foot chambers used in most cases are only a fraction the size of a typical room. In their instructions, Defendants recommend using one repeller per “averaged-sized room” which they define as 120 square feet (Bell+Howell 2017) —a dimension 7.5 times larger than the square footage of their test arenas. Within buildings, cockroaches, ants, spiders and rodents dwell in three dimensions with many of the prime harborage areas well above floor level (e.g., within and above cabinets, shelves, appliances, walls, windows, and ceilings). If a room has 8-ft ceilings, an “average-sized room” warranting one Bell + Howell repeller would have a cubic dimension of 960 feet — *40 times larger* than the 24-foot cubic dimension of their plastic chambers. The most common occupied room for pests within homes is typically the kitchen, with average dimensions exceeding 300 square feet (NAHB 2013) —almost 20 times larger (square footage) and *100 times larger* (cubic footage) than the enclosures used in these tests. The likelihood that sufficient numbers of units would be purchased by consumers and configured to comprehensively treat such large, complex spaces (not to mention attics, garages, basements, and crawlspaces) seems unlikely, especially since ultrasonic and electromagnetic waves diminish in intensity at short distances from the transducer (Gold et al. 1984, Shumake 1995).

88. Homes and buildings are much more complex environments than the rudimentary enclosures used in these tests. Pests seldom reside in open, unprotected spaces (like the non-natural confines of an empty plastic chamber), preferring instead to nest and forage in concealed locations. Ultrasonic waves are directional and unable to bend around or penetrate objects. This results in untreated “sound shadows” on the other side (Wood, 1986, Bomford and O’Brien 1990, Frantz and Davis 1991, Corrigan 2001). The retail packaging for the Bell + Howell devices states: “Ultrasonic signals cannot reach nesting or feeding places behind walls, under floors, or within cracks.”<sup>12</sup> The same would be true of cracks and voids within cabinets, closets, furniture, appliances, stored items, ceilings, etc. — the very places pests hide within homes and buildings. Oftentimes the majority of pests observed in homes are nesting and breeding in attics and crawlspaces (not to mention outdoors), where outlets are even scarcer— further negating the possible usefulness of ultrasound.

89. As rodent, cockroach, and ant infestations become established, they emit pheromones in their urine, droppings, and other secretions. Accumulating in greater and great amounts, the odors serve to attract and retain others of the same species. Since the Bell + Howell pest repellents are marketed to control existing infestations, they would need to overpower these aggregating odors in order to “drive pests out” of buildings. Test chambers used by Defendants lacked suitable harborage that would have enabled pests to congregate and concentrate such odors. Nonporous surfaces such as plastic are also less favored for deposition of pheromones compared to porous substrates like fabric, wood, paper, or sheetrock. No mention was made whether any of the test chambers were cleaned between experiments. Since the attractants in

---

<sup>12</sup> Bates Number BHH,LLC006664.

such secretions are often quite persistent, failure to clean enclosures between experiments could further bias results.

90. In a USDA Wildlife Research Center review of electronic repellent devices, testing protocols and enforcement, Shumake (1995) concludes: “Efficacy of an electronic rodent repellent device as demonstrated or supported statistically in field structures or open field plots is, of course, the ultimate requirement for identifying practical and useful products. All the laboratory and enclosure evaluations together may indicate some high level of sustained repellency; but, if these effects do not appear consistently with free ranging rodents in actual rodent infestation conditions, the device should not be on the market.” Defendants were informed of the need for such real-world evaluations in a pre-registration consult with the Canadian Pest Management Regulatory Agency. “Efficacy data generated under small cage conditions are not acceptable to support use claims due to limitations of confined small cage trials (e.g., size) and the nature of the product (e.g., loss of intensity/sound pressure level with increasing distance). Field trials or laboratory trials which simulate realistic conditions must be conducted” (BHH, LLC 001361). The only Bell + Howell tests involving enclosures larger than 4 x 4 x 1.5 feet were BHH, LLC 000713, conducted in a 2901 sq. ft. building with six interconnected rooms, and BHH, LLC 001812, performed in two rooms with a combined area of 372 sq. ft. Few conclusions can be reached from either test due to numerous problems with the experimental design (no statistics; no untreated controls; insufficient sample sizes; confounding effects from placing cockroaches, spiders and mice together in the same enclosure; use of white laboratory mice; no protective harborages...). Thus, there is no basis for Defendants’ assertions that the effective range/area of coverage for the devices was 2901 sq. ft. and 372 sq. ft.

91. If insects, spiders, and rodents did happen to avoid the devices, control of infestations still would be unlikely since they would simply relocate elsewhere in the building. Using repellents indoors often makes pest problems worse since the displaced individuals often repopulate in harder to reach locations (behind and between walls, floors, and ceilings; deep within clutter and storage; hidden voids of cabinets, appliances and furniture; etc.). This is why most professionals prefer to use non-repellent materials when servicing within buildings. Some of the most challenging pest problems I have encountered were made worse by the use of repellent materials indoors by householders.